EXPERIMENT E7: COMMON EMITTER AMPLIFIER

Related course: KIE1007 (Electronic Circuit I)

OBJECTIVES:
1. To construct common emitter amplifier circuit
2. To measure input and output resistance of common emitter amplifier circuit

EQUIPMENT:
Oscilloscope; function generator; DC power supply; breadboard; multimeter; wires/jumpers; BJT BC140 (1 unit); resistors: 4.7kΩ (1), 1kΩ (2), 150kΩ (1), 10kΩ (1); capacitors: 1uF (1), 10uF (2); variable resistor 50kΩ (1)

INSTRUCTIONS:
1. Record all your results and observations in a log book or on a piece of paper
2. Follow the demonstrator's instructions throughout the experiment

REFERENCES:
Refer to the main references of KIE1007

TESTS:
PRE-TEST: Simulation of common emitter amplifier
TEST 1: Setting operating point of transistor
TEST 2: Measuring input and output resistance

Resistor **Capacitor**

INTRODUCTION:

In common emitter amplifier circuit, the base of the transistor serves as the input, the collector as the output and the emitter is common to both (for example, it may be connected to ground). It is typically used as a voltage amplifier.

Parameter	Common Base	Common Emitter	Common Collector
Voltage gain, V_{gain}	High	High	< 1
Current gain, I_{gain}	< 1	High	High
Input resistance, r_{in}	Low (~Ω)	Moderate (~kΩ)	High (~kΩ)
Output resistance, r_{out}	High (~MΩ)	Moderate (~kΩ)	Low (~Ω)

PROCEDURE:

TEST 1: Setting operating point of transistor
1. Construct the circuit as shown in Figure 1 on a breadboard.
2. Using a DC power supply, apply +10V DC (red clip) at P1 and 0V (black clip) at P4.
3. Set the operating point (or Q-point) of the transistor to V_{CE} = 5V (or 0.5 x V_{CC}) by adjusting the variable resistor R_4. V_{CE} is measured across P7 and P8 using a multimeter (place red probe at P7 and black probe at P8).
4. Remove the multimeter. Connect the probe hook clip of the oscilloscope CH1 to point P2 and its croc clip to P4. Connect the probe hook clip of the oscilloscope CH2 to point P10 and its croc clip to P4. Switch ON the function generator and apply a sinusoidal voltage of V_{in} = 1 Vpp, f = 1 kHz at P2 (red clip) and 0V (black clip) at P4. CH1 is now displaying V_{in} (input) and CH2 is displaying V_{out} (output).
5. Save the voltage curves from the oscilloscope in a pendrive or capture the figure using a camera. Record the peak-to-peak voltage of V_{in} and V_{out}. Then, calculate the voltage gain using $V_{gain} = V_{out}/V_{in}$ = __________ / __________ = ____________

TEST 2: Measuring input and output resistance

1. Switch OFF the function generator and DC power supply. Change the position of the red clip of the function generator from P2 to P3. Leave the other clip remained at P4.
2. Change the position of the probe hook clip of the oscilloscope CH1 from point P2 to P3 and its croc clip remained at P4.
3. Switch ON the DC power supply and apply +10V DC at P1 and 0V at P4.
4. Switch ON the function generator and apply a sinusoidal voltage of V_{in} = 1 Vpp, f = 1 kHz at P3 and 0V at P4.
5. Measure the rms voltage across R_1 using a multimeter by connecting its red probe to P2 and black probe to P3. This voltage is V_{R1rms}. Then, remove the multimeter.
6. Calculate the input resistance r_{in} using:

   $I_{in\ pp} = V_{R1rms} \times 2\sqrt{2} / R_1$ = (__________ / __________) = ____________ (Amp pp)

   $r_{in} = V_{in\ pp} / I_{in\ pp}$, = __________ / __________ = ____________
7. Measure V_{out} using oscilloscope CH2 between P10 and P4. This voltage is named V_{out0} or output voltage at no load. Then, connect R_0 = 1kΩ between P10 and P4. Measure V_{out} using CH2 between P10 and P4. This voltage is named $V_{outload}$ or output voltage with the load. Note that the oscilloscope is showing pp value, not rms value.
8. Calculate the output resistance r_{out} using:

   $r_{out} = (V_{out0} - V_{outload})/(V_{outload} / R_0)$ = __________ / __________ = _____________

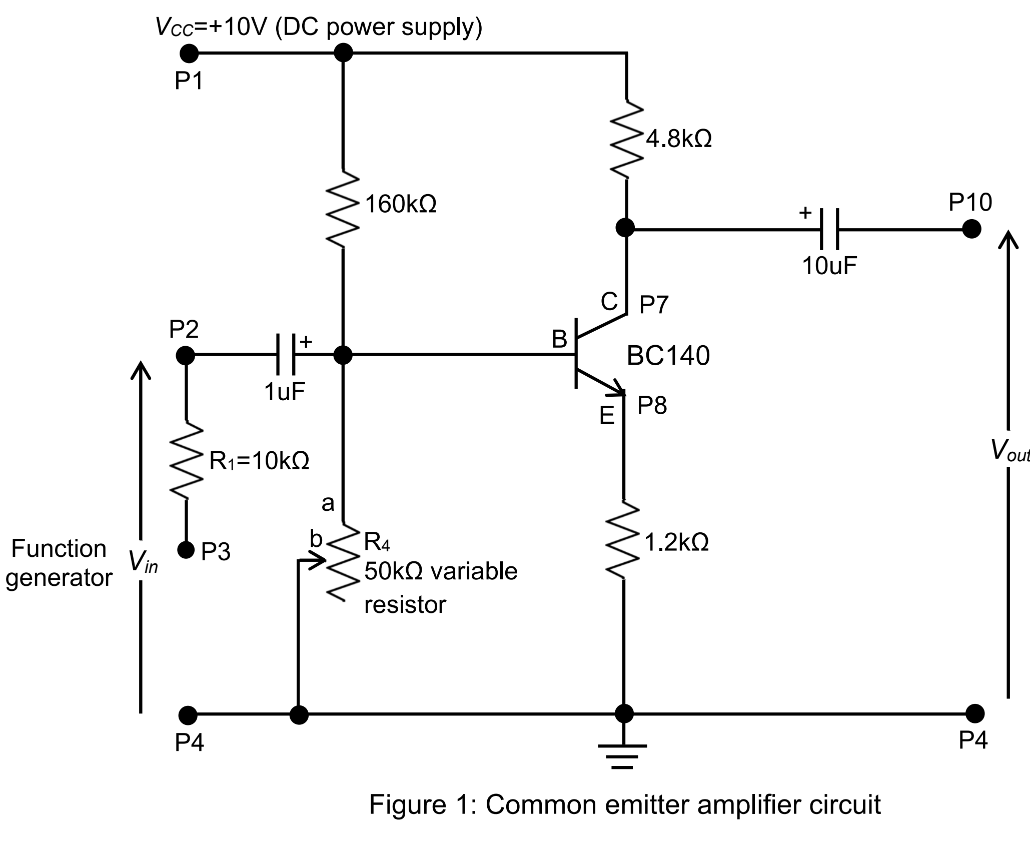
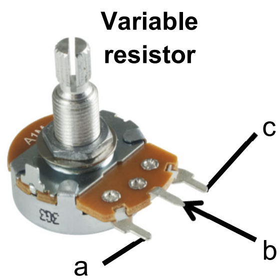


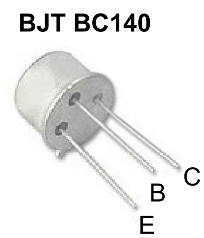
Figure 1: Common emitter amplifier circuit

DISCUSSION:

1. Describe the operation of the common emitter amplifier.
2. Given that the expression for the collector current to be: $I_c = (\alpha / (1- \alpha))\, I_B + (\alpha / (1- \alpha))\, I_{CB0}$. A germanium transistor with $\alpha = 0.98$ gives a reverse saturation current of approximately 10 μA when configured in the common-base configuration. If this transistor is to be used in the CE configuration, what is the range of the base current if the desired collector current to be in the range of 0.3 mA to 0.5 mA.
3. The basic grounded common emitter amplifier ($R_E = 0$) is regarded to experience temperature instability. By including R_E tends to remedy this problem. Explain how this is possible.

APPENDIX:





END OF EXPERIMENT